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Antarctic ice shelf fracture parameterization in an ice sheet model

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Floating ice shelves exert a stabilizing force onto the inland ice sheet of Antarctica. However, the buttressing effect is diminished beyond the shear-thinning implied by Glen's Law by fracture processes, which weaken the ice shelf. Here, we add a continuum damage model to the prognostic ice sheet model BISICLES. Damage in a unit volume is determined by the damage transported from upstream and the stress field in the volume. Since damage alters the relationship between the strain-rate and stress tensors, we compute the velocity and damage fields at the same time. In order to evaluate the physical role of fracture process on large-scale ice sheet dynamics and also the importance of parameters used in the damage model, we carry out a suite of numerical experiments based on the MISMIP+ marine ice sheet geometry.